Students' Perception of Robotics as a Trade Subject in Secondary Schools in Rivers State

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Abstract
This study investigated secondary school students' perceptions of robotics as a trade subject in Rivers State, Nigeria. Guided by three research questions and three null hypotheses tested at the 0.05 level of significance, the study adopted a descriptive survey research design. From a population of 68,450 Senior Secondary School Two (SS2) students across public and private schools in Rivers State, a sample of 400 students was drawn using a multistage sampling technique, with 384 valid responses analyzed. Data were collected using a validated, researcher-structured instrument titled Students' Perception of Robotics as a Trade Subject Questionnaire (SPRTSQ), which yielded a Cronbach's alpha reliability coefficient of α≥0.70. Mean and standard deviation were used to answer the research questions against a 2.50 criterion benchmark, while independent samples t-tests were used to test the hypotheses. The findings revealed that secondary school students strongly perceive robotics as a relevant trade subject for 21st-century skill acquisition, self-reliance, and STEM career development (X^{-}=3.23, SD=0.76). However, effective learning is substantially hindered by infrastructural and pedagogical challenges (X^{-}=3.26, SD=0.74), foremost among them erratic electricity supply, inadequate functional robotics kits, and a shortage of qualified instructors. Furthermore, school location significantly influenced student perception, with urban students (X^{-}=3.29) holding significantly more favorable views than their rural counterparts (X^{-}=2.48, $p<0.05$). While no significant gender difference existed regarding the perceived relevance of robotics ($p>0.05$), public school students reported significantly higher learning challenges than private school students ($p<0.05$). The study concluded that bridging the urban-rural and public-private infrastructural divides is essential to translating students' positive enthusiasm into sustainable vocational competence.

Keywords: *Robotics education, trade subjects, student perception, STEM pedagogy, secondary schools, Rivers State*

Introduction

The incorporation of robotics into the secondary school curriculum in Nigeria, especially in the context of entrepreneurship and trade courses, signifies a substantial change from rote learning to immersive, hands-on STEM education. Secondary school students' opinions on robotics as a trade subject are influenced by both specific infrastructural and socioeconomic realities and a

passion for contemporary digital skills in Rivers State, a significant industrial and educational center in the Niger Delta. Secondary school students in Rivers State's urban and semi-urban areas, especially in Local Government Areas like Port Harcourt and Obio-Akpor, are beginning to see robotics as an exciting, forward-thinking topic rather than an abstract academic discipline.
Students' enthusiasm for creating and programming working prototypes has been shown by exposure to state-level programs like the Niger Delta Development Commission and regional technology fairs like the NDI Robotics and STEM Fair. According to Zhong and Xia (2020), many students saw robotics as a straight route to profitable jobs in the fields of engineering, software development, and industrial automation, all of which are closely related to the state's oil, gas, and maritime industries. As a result, students frequently view robotics as more realistically applicable to the workforce of the twenty-first century than traditional trade topics like bookkeeping, animal husbandry, or dyeing and bleaching (Yang, 2022).
In general, students view robots as a life-changing educational opportunity that demystifies difficult scientific ideas. Robotics engages students in active problem-solving, critical thinking, and cooperative teamwork, in contrast to typical classroom instruction that is dominated by theoretical note-taking (Wallace and Poulopoulos, 2022). Students show greater levels of intrinsic motivation and classroom participation when they assemble microcontrollers, sensors, and mechanical components (Tzagkaraki et al., 2021). Seeing a coded instruction translated into physical movement helps students understand the connection between real-world engineering and abstract physics or mathematical calculations. Students' self-perception changes from being passive consumers of foreign technology to competent creators and innovators as a result of this practical validation, which increases their self-efficacy (Tytler et al., 2021).
Students' views are tempered by practical concerns about implementation, even though they have strong favorable emotions about the subject's importance. Students at many public and low-cost private secondary schools in Rivers State are aware of serious infrastructure deficiencies, including as inconsistent energy supply, subpar computer labs, poor internet connectivity, and a lack of actual robotics kits. Students become less enthusiastic and the subject is seen as unduly abstract and challenging when schools rely on theoretical explanations of robotics since hardware is unavailable (Taole, 2020). Additionally, student perceptions are influenced by gender and socioeconomic inequities. According to Mury et al. (2022), students from underprivileged rural or riverine communities frequently view robotics as an elite topic only available in well-funded metropolitan schools, creating a sense of isolation. Similarly, unless intentional mentorship and inclusive Technovation Clubs are developed, lingering cultural preconceptions can sometimes cause female students to perceive hardware assembly and coding as male-dominated fields. Lastly, some senior secondary students have concerns about how robotics is evaluated in external standardized tests, fearing that their total grades may suffer due to a lack of core knowledge in programming and mathematics (Sáez-López, et al., 2019).
Secondary school students in Rivers State hold a predominantly favorable perception of robotics as a trade subject, recognizing its potential to foster creativity, self-reliance, and global competitiveness. However, translating this positive disposition into sustained academic and vocational competence requires bridging the gap between curriculum policy and classroom reality through consistent power supply, affordable instructional kits, and well-trained teachers.

Statement of the Problem

In order to provide graduates with useful, marketable skills for independence and economic production, trade and entrepreneurship courses were incorporated into Nigeria's senior secondary

school curriculum. Recent years have seen the identification of developing technologies, especially robots, as key forces behind digital innovation, industrial automation, and employment in the twenty-first century. Introducing robotics as a trade topic in secondary schools has significant potential to match young vocational training with contemporary technology demands, given Rivers State's status as a major industrial, oil and gas, and maritime hub in the Niger Delta. However, how students view the relevance, usability, and accessibility of a new vocational subject is crucial to its successful adoption and long-term viability. Although STEM and robotics programs are being promoted more widely throughout Rivers State by legislators, educators, and technology advocates, there is still a dearth of factual data regarding secondary school students' perceptions of robotics as a trade subject. Traditional trades continue to dominate vocational education in many schools, and students may have conflicting opinions about whether robotics is an exclusive, overly complicated field unrelated to their everyday lives or a feasible, accessible career path. Additionally, ongoing pedagogical and infrastructure issues in Rivers State's secondary schools such as inconsistent power supplies, poor ICT facilities, expensive robotics kits, a lack of qualified teachers, and differences between urban and rural/riverine schools threaten to lower student engagement. Students may have negative attitudes, low self-efficacy, or exam anxiety when robotics is taught only conceptually without practical hardware, and female students and students from low-income families run the risk of feeling left out. Curriculum designers and school administrators run the danger of funding interventions that don't result in significant student uptake if they don't have a thorough grasp of students' attitudes, perceived utility, ease of use, and perceived obstacles. Thus, the purpose of this study is to find out how Rivers State secondary school students view robotics as a trade topic.

Aim and Objectives of the Study

The aim of this study is to investigate secondary school students' perception of robotics as a trade subject in Rivers State. Specifically, the objectives of the study are to:

1. determine the perception of secondary school students regarding the relevance of robotics as a trade subject for skill acquisition and career development in Rivers State.
2. ascertain the perceived challenges hindering secondary school students' effective learning of robotics as a trade subject in Rivers State.
3. examine the extent to which school location (urban and rural) influences secondary school students' perception of robotics as a trade subject in Rivers State.

Research Questions

The following research questions guided the study:

1. What is the perception of secondary school students regarding the relevance of robotics as a trade subject for skill acquisition and career development in Rivers State?
2. What are the perceived challenges hindering secondary school students' effective learning of robotics as a trade subject in Rivers State?
3. To what extent does school location influence secondary school students' perception of robotics as a trade subject in Rivers State?

Hypotheses

The following null hypotheses were formulated and tested at the 0.05 level of significance:

H01: There is no significant difference between the mean perception scores of male and female secondary school students regarding the relevance of robotics as a trade subject in Rivers State.

H02: There is no significant difference between the mean ratings of public and private secondary school students on the perceived challenges hindering the effective learning of robotics as a trade subject in Rivers State.
H03: There is no significant difference between the mean perception scores of urban and rural secondary school students regarding robotics as a trade subject in Rivers State.

Methodology

The study adopted a descriptive survey research design. The population of the study comprised 68,450 Senior Secondary School Two (SS2) students across public and private secondary schools in Rivers State. SS2 students were chosen because they had selected their trade subjects without the distraction of external certificate examinations like SS3 students. A sample size of 400 SS2 students was drawn via a multistage sampling technique. First, stratified random sampling was used to stratify Rivers State into its three senatorial districts (Rivers East, Rivers South-East, and Rivers West) and categorize schools by location (urban and rural) and ownership (public and private). Second, purposive sampling was employed to select two Local Government Areas (LGAs) per senatorial district with schools offering ICT, STEM, or robotics-related trade programs. Third, simple random sampling was used to select 20 secondary schools (10 public, 10 private; 10 urban, 10 rural) and 20 SS2 students per school, totaling 400 respondents. Data were collected using a structured questionnaire titled Students' Perception of Robotics as a Trade Subject Questionnaire (SPRTSQ), which was divided into Section A (demographics: gender, school type, and location) and Section B (24 items across three clusters rated on a 4-point Likert scale: Strongly Agree = 4 to Strongly Disagree = 1, with a 2.50 criterion mean). Face and content validity were established by three experts from the University of Port Harcourt. Reliability was determined via a pilot test with 30 SS2 students outside the sampled LGAs, yielding an acceptable Cronbach's Alpha (αα) coefficient of 0.70 or higher using IBM SPSS Statistics (Version 27.0). The researcher and two assistants administered and retrieved the questionnaires on the spot. Data were analyzed using Mean ($\bar{X}$) and Standard Deviation (SD) to address the research questions (criterion mean = 2.50), while independent samples tt-tests were used to test the hypotheses (H01, H02, H03) at the 0.05 level of significance.

Results

Research Question 1: What is the perception of secondary school students regarding the relevance of robotics as a trade subject for skill acquisition and career development in Rivers State?

Table 1: Relevance of robotic as a trade subject

S/N	Item Statement	$\bar{X}$	*SD*	Decision
1	Robotics equips students with practical 21st-century technological skills.	3.42	0.68	Agreed
2	Learning robotics prepares students for lucrative careers in engineering and automation.	3.35	0.72	Agreed
3	Robotics fosters creativity, critical thinking, and real-world problem-solving abilities.	3.28	0.75	Agreed
4	Robotics is more relevant to modern industrial needs than traditional trade subjects.	3.10	0.81	Agreed
5	Knowledge of robotics increases students' potential for self-reliance after graduation.	3.19	0.79	Agreed

6	Robotics makes abstract concepts in physics and mathematics easier to understand.	3.04	0.84	Agreed
7	Studying robotics enhances students' global competitiveness in the digital economy.	3.31	0.70	Agreed
8	Students feel motivated to pursue STEM courses at the tertiary level through robotics.	3.15	0.77	Agreed
	Cluster Mean	**3.23**	**0.76**	**Agreed**

Table 1 presents the mean ratings and standard deviations of secondary school students' perceptions of the relevance of robotics as a trade subject in Rivers State. All eight items scored above the 2.50 criterion benchmark, indicating general agreement. The highest-rated items were item 1 on equipping students with 21st-century technological skills ($\bar{X}$=3.42, *SD*=0.68), item 2 on career preparation in engineering and automation ($\bar{X}$=3.35, *SD*=0.72), and item 7 on global competitiveness ($\bar{X}$=3.31,*SD*=0.70). Item 6, on simplifying abstract physics and mathematics concepts, recorded the lowest mean ($\bar{X}$=3.04, *SD*=0.84) but still exceeded the benchmark. The low standard deviations (0.68–0.84) reflect high consensus among respondents. With a cluster mean of 3.23 (*SD*=0.76), the results indicate that students strongly perceive robotics as relevant for skill acquisition, self-reliance, and STEM career development.

Research Question 2: What are the perceived challenges hindering secondary school students' effective learning of robotics as a trade subject in Rivers State?

Table 2: Perceived Challenges Hindering Effective Learning

S/N	Item Statement	$\bar{X}$	*SD*	Decision
1	Inadequate supply of functional robotics kits and microcontrollers in schools.	3.48	0.65	Agreed
2	Erratic electricity supply disrupts practical robotics sessions in the laboratory.	3.54	0.61	Agreed
3	Shortage of qualified teachers with hands-on expertise in robotics and coding.	3.26	0.74	Agreed
4	Over-reliance on theoretical teaching rather than practical hardware assembly.	3.32	0.71	Agreed
5	High cost of personal components limits students' ability to practice at home.	3.39	0.69	Agreed
6	Poor internet connectivity restricts access to online programming resources.	3.18	0.80	Agreed
7	Insufficient time allocated to robotics practicals on the school timetable.	3.05	0.83	Agreed
8	Weak foundational background in mathematics and computer programming.	2.88	0.89	Agreed
	Cluster Mean	**3.26**	**0.74**	**Agreed**

Table 2 shows the mean ratings and standard deviations of challenges hindering students' effective learning of robotics. Respondents agreed with all eight items, as every mean exceeded 2.50. The foremost barriers were erratic electricity supply (item 2: $\bar{X}$=3.54, *SD*=0.61), inadequate robotics kits and microcontrollers (item 1: $\bar{X}$=3.48,*SD*=0.65), and the high cost of personal components (item 5: $\bar{X}$=3.39,*SD*=0.69). Over-reliance on theory ($\bar{X}$=3.32), shortage of qualified teachers ($\bar{X}$=3.26), poor internet ($\bar{X}$=3.18), insufficient timetable allocation ($\bar{X}$=3.05), and weak math/coding foundations ($\bar{X}$=2.88) also posed notable challenges. Standard deviations

ranged from 0.61 to 0.89, showing consistent agreement. The cluster mean of 3.26 (*SD*=0.74) confirms that infrastructural deficits, inadequate hardware, and limited teacher expertise substantially hinder practical robotics instruction.

Research Question 3: To what extent does school location influence secondary school students' perception of robotics as a trade subject in Rivers State?

Table 3: **Influence of School Location on Students' Perception**

S/N	Item Statement	*Urban (N=196)* $\bar{X}^{-1}$	*SD1*	**Rural (N=188)** $\mathbf{X^2}$	**SD2**	**Decision**
1	Exposure to tech fairs and coding clubs boosts interest in robotics.	3.45	0.66	2.62	0.88	Agreed
2	Availability of ICT laboratories supports positive attitudes toward robotics.	3.38	0.70	2.41	0.92	Disagree (Rural)
3	Robotics is perceived as an accessible trade subject for all students.	3.21	0.75	2.38	0.95	Disagree (Rural)
4	Proximity to industrial and tech hubs reinforces career relevance.	3.34	0.72	2.55	0.89	Agreed
5	Access to external mentorship encourages active participation.	3.16	0.78	2.32	0.91	Disagree (Rural)
6	Students feel confident operating digital hardware and sensors.	3.29	0.73	2.46	0.90	Disagree (Rural)
7	Community awareness promotes parental support for robotics education.	3.12	0.80	2.44	0.93	Disagree (Rural)
8	Robotics is viewed as a viable pathway to self-employment.	3.33	0.71	2.66	0.86	Agreed
	Cluster Mean	**3.29**	**0.73**	**2.48**	**0.91**	**High vs. Low Extent**

Table 3 compares the mean ratings and standard deviations of urban (*N*=196) and rural (*N*=188) students regarding how school location influences their perception of robotics. Urban students agreed with all eight items, with means ranging from 3.12 to 3.45—led by exposure to tech fairs and coding clubs ($\bar{X}1$=3.45, *SD*1=0.66) and ICT laboratory availability ($\bar{X}1$=3.38, *SD*1=0.70). Conversely, rural students disagreed with five items scoring below 2.50, notably lacking external mentorship ($\bar{X}2$=2.32, *SD*2=0.91), accessibility ($\bar{X}2$=2.38, *SD*2=0.95), and ICT laboratories ($\bar{X}2$=2.41, *SD*2=0.92), agreeing only on items 8, 1, and 4 regarding career and self-employment value. Urban students recorded a high cluster mean of 3.29 (*SD*1=0.73) compared to rural students' low cluster mean of 2.48 (*SD*2=0.91). This gap shows that school location significantly shapes student perception, with urban students holding a much more favorable view due to superior infrastructure and exposure.

Hypotheses

H01: There is no significant difference between the mean perception scores of male and female secondary school students regarding the relevance of robotics as a trade subject in Rivers State.

Table 4: Independent Samples *t*-test Analysis of the Difference between the Mean Perception Scores of Male and Female Secondary School Students Regarding the Relevance of Robotics as a Trade Subject in Rivers State

Gender	**N**	$\bar{X}$	*SD*	*Df*	*t*-cal	*p*-value	α	*Decision*
Male	198	3.26	0.74	382	0.81	0.418	0.05	Retain *H*01
Female	186	3.20	0.78					

Table 4 presents the independent samples *t*-test analysis comparing the mean perception scores of males (N=198, $\bar{X}$=3.26, SD=0.74) and female (N=186, $\bar{X}$=3.20, SD=0.78) secondary school students regarding the relevance of robotics as a trade subject in Rivers State. With 382 degrees of freedom (*df*), the calculated *t*-value is 0.81 and the *p*-value is 0.418. Since the *p*-value (0.418) is greater than the 0.05 level of significance (p>0.05), the null hypothesis (*H*01) is retained. This indicates that there is no statistically significant difference between the mean perception scores of male and female students on the relevance of robotics.

H02: There is no significant difference between the mean ratings of public and private secondary school students on the perceived challenges hindering the effective learning of robotics as a trade subject in Rivers State.

Table 5: Independent Samples *t*-test Analysis of the Difference between the Mean Ratings of Public and Private Secondary School Students on Perceived Challenges Hindering the Effective Learning of Robotics as a Trade Subject in Rivers State

School Ownership	**N**	$\bar{X}$	*SD*	*Df*	*t*-cal	*p*-value	α	*Decision*
Public Schools	194	3.49	0.64	382	6.42	0.000	0.05	Reject *H*02
Private Schools	190	3.02	0.79					

Table 5 displays the independent samples *t*-test comparison of the mean ratings of public (N=194, $\bar{X}$=3.49, SD=0.64) and private (N=190, $\bar{X}$=3.02, SD=0.79) secondary school students regarding the challenges hindering the effective learning of robotics. At 382 degrees of freedom (*df*), the analysis yielded a calculated *t*-value of 6.42 and a *p*-value of 0.000. Because the *p*-value (0.000) is less than the 0.05 alpha threshold (p<0.05), the null hypothesis (*H*02) is rejected. Consequently, there is a statistically significant difference between the two groups, with public secondary school students experiencing significantly higher levels of infrastructural and instructional challenges than their private school counterparts.

H03: There is no significant difference between the mean perception scores of urban and rural secondary school students regarding robotics as a trade subject in Rivers State.

Table 6: Independent Samples *t*-test Analysis of the Difference between the Mean Perception Scores of Urban and Rural Secondary School Students Regarding Robotics as a Trade Subject in Rivers State

School Location	**N**	$\bar{X}$	*SD*	*Df*	*t*-cal	*p*-value	α	*Decision*
Urban Schools	196	3.29	0.73	382	9.64	0.000	0.05	Reject *H*03
Rural Schools	188	2.48	0.91					

Table 6 illustrates the independent samples *t*-test analysis of the mean perception scores of urban (N=196, $\bar{X}$=3.29, SD=0.73) and rural (N=188, $\bar{X}$=2.48, SD=0.91) secondary school students toward robotics as a trade subject in Rivers State. At 382 degrees of freedom (df), the calculated *t*-value is 9.64 with a corresponding *p*-value of 0.000. Since the *p*-value (0.000) is below the 0.05 level of significance (p<0.05), the null hypothesis (H03) is rejected. This confirms a statistically significant difference in perception based on school location, with urban secondary school students holding a significantly more favorable perception of robotics than rural secondary school students.

Discussion of Findings

Research Question 1: What is the perception of secondary school students regarding the relevance of robotics as a trade subject for skill acquisition and career development in Rivers State?

The results of this study are in line with previous empirical research on the educational benefits of robotics for secondary school students' learning of practical skills, preparation for the workforce, and development of attitudes. In particular, students' favorable opinions of robotics as a useful trade subject support the findings of Koca and Türkoğlu (2022), who discovered that secondary school students had largely favorable opinions of educational robotics applications. They reported that the activities enhanced their interest in science, helped them connect classroom lessons with everyday life, and improved their coding, engineering, and teamwork skills, despite the fact that students initially encountered coding challenges and time constraints during group projects. Nugent et al. (2010) found that students who participated in an intensive, multi-day robotics and geospatial intervention achieved significantly greater STEM content learning gains and more positive STEM attitudes than a control group, whereas a brief 3-hour exposure boosted motivation, problem-solving, and teamwork without yielding substantial content mastery. This finding is consistent with the recognition of sustained hands-on training as a driver of technical competence. This emphasizes how important it is to present robotics as an organized, multi-term trade subject rather than a one-time extracurricular session in order to achieve true skill acquisition. Additionally, Sisman et al. (2021) found that taking part in a long-term (31-week) robotics training course significantly improved learners' spatial abilities (specifically, spatial visualization and mental rotation) along with their general attitudes toward STEM and 21st-century workforce skills, supporting the alignment between robotics instruction and core vocational competencies like mechanical design, electronics, and algorithmic thinking.

Lastly, these student-centered results support the findings of Khanlari and Mansourkiaie (2015), who discovered that educators generally had positive views of robotics for improving lifelong learning, mathematical reasoning, problem-solving, and communication skills. However, they cautioned that in order to fully realize robotics' potential in schools, infrastructural deficiencies like insufficient robotics hardware, limited timetable allocation, lack of technical support, and inadequate teacher training must be addressed.

Research Question 2: What are the perceived challenges hindering secondary school students' effective learning of robotics as a trade subject in Rivers State?

According to Nashir et al. (2019), students' capacity to develop vocational and technical abilities in robotics is severely hampered by technological limitations such inadequate laboratory facilities, infrastructural deficiencies, and the lack of systematic evaluation tools. Many educators have low technical self-efficacy and insufficient experience in hardware administration and coding, according to Papadakis et al. (2021). They came to the conclusion that teachers who get inadequate in-service professional development are ill-prepared to oversee student-led technical projects or troubleshoot equipment.

According to Hall-Lay (2018), psychological obstacles such as low self-efficacy, math/technology anxiety, and enduring cultural stereotypes that associate hardware engineering primarily with men seriously impair female students' confidence, performance, and active engagement in robotics tasks. According to Tselegkaridis and Sapounidis (2021), a significant institutional obstacle is the exorbitant cost of physical robotics kits, sensors, and continuing maintenance components. They pointed out that kit-to-student ratios are often too expensive for secondary schools, which limits practical experience.

Research Question 3: To what extent does school location influence secondary school students' perception of robotics as a trade subject in Rivers State?

According to Álvarez-Álvarez & García-Prieto (2021), there is a substantial structural digital divide between rural and urban schools, which is typified by inadequate internet access, a shortage of hardware and devices, and a lower level of digital preparedness. The exposure of rural students to cutting-edge digital tools and technology-based learning is directly limited by these location-based deficiencies. According to Wallace & Poulopoulos (2022), socioeconomic and geographic factors significantly influence access to educational robotics. Due to structural obstacles (such as expensive equipment and a lack of qualified facilitators), students in underprivileged or non-urban areas are unable to interact with robotics and are less likely to see it as a feasible academic or professional path.

Geographical isolation in rural areas exacerbates technical inequality, according to Soto, Ruiz, and Aguilera (2021). There are differences in how practical and technical curriculum are received since rural students are less familiar with technology and have less institutional support for hands-on technical topics than their urban counterparts. According to Bampasidis et al. (2021), secondary school students' engagement, engineering mindset, and perception of robotics as a useful, real-world technical skill are all greatly enhanced when they are given hands-on exposure to applied robotics projects. This indicates that direct access to equipment is the main factor influencing positive student perception.

Conclusion

Regardless of gender, Rivers State secondary school students see robotics as a very important, forward-thinking trade topic that may promote creativity, technological independence, and global workforce competitiveness. However, serious implementation bottlenecks specifically, unstable power supplies, insufficient physical robotics kits, an excessive dependence on theoretical training, and a lack of technically skilled teachers undermine this strong favorable tendency. Additionally, there are notable differences in school ownership and geography: students in public schools encounter considerably more educational challenges than their peers in private schools, and students in rural areas believe robotics is much less accessible than students in urban areas because of the lack of laboratory facilities and outside mentorship. In the end, achieving the career potential of robotics in Rivers State's senior secondary curriculum necessitates going beyond the implementation of policies to provide fair, practical infrastructure and instructional support in all schools.

Recommendations

1. The Rivers State Ministry of Education, alongside the NDDC and private sector partners, should equip public and rural secondary schools with affordable robotics kits and solar-inverter power systems to support hands-on learning.
2. The Rivers State Senior Secondary Schools Board (RSSSSB) should organize regular, practical workshops in coding and hardware assembly to improve teachers' technical competence.
3. Educational administrators and urban technology hubs should deploy mobile robotics labs and mentorship programs to underserved rural schools to bridge the urban-rural accessibility gap.

References

Álvarez-Álvarez, C., & García-Prieto, F. J. (2021). Rural schools and the digital divide in Spain: Challenges and opportunities for educational equity. Revista Española de Pedagogía, 79(279), 265–282. https://doi.org/10.22550/REP79-2-2021-04

Bampasidis, G., Galani, L., & Koutromanos, G. (2021). Astronomy in education: Simulating space missions with educational robotics in secondary schools. European Journal of Science and Mathematics Education, 9(4), 192–207. https://doi.org/10.30935/scimath/11206

Bellas, F., Salgado, M., Blanco, T. F., & Duro, R. J. (2019). Robotics in primary school: A realistic mathematics approach. In Smart learning with educational robotics (pp. 149–182). Springer.

Hall-Lay, J. A. (2018). Female students' self-efficacy and attitudes toward robotics in secondary education [Doctoral dissertation, Liberty University]. Scholars Crossing. https://digitalcommons.liberty.edu/doctoral/1742/

Khanlari, A., & Mansourkiaie, F. (2015). Using robotics for STEM education in primary/elementary schools: Teachers' perceptions. 2015 10th International Conference on Computer Science & Education (ICCSE), 3–7. https://doi.org/10.1109/ICCSE.2015.7250211

Koca, İ., & Türkoğlu, A. (2022). Secondary school students' views on educational robotics applications. International Journal of Technology in Education and Science, 6(2), 342–360. https://doi.org/10.46328/ijtes.371

Mury, S. R., Negrini, L., Assaf, D., & Skweres, M. (2022). How to support teachers to carry out educational robotics activities in school? The case of Roteco, the Swiss robotic teacher community. In Proceedings of the IEEE Frontiers in Education Conference (FIE) (pp. 1–5). IEEE.

Nashir, I. M., Mustapha, R., Maarof, N. N. M. I., & Rui, T. J. (2019). Modified Delphi technique: The development of measurement model for innovative instructional leadership in technical and vocational education systems. Journal of Technical Education and Training, 11(1), 24–33. https://doi.org/10.30880/jtet.2019.11.01.004

Nugent, G., Barker, B., Grandgenett, N., & Adamchuk, V. I. (2010). Impact of robotics and geospatial technology interventions on youth STEM learning and attitudes. Journal of Research on Technology in Education, 42(4), 391–408. https://doi.org/10.1080/15391523.2010.10782557

Papadakis, S., Vaiopoulou, J., Sifaki, E., Stamovlasis, D., & Kalogiannakis, M. (2021). Attitudes towards the use of educational robotics: Exploring pre-service and in-service early childhood teacher profiles. Education Sciences, 11(5), Article 204. https://doi.org/10.3390/educsci11050204

Sáez-López, J. M., Sevillano-García, M. L., & Vazquez-Cano, E. (2019). The effect of programming on primary school students' mathematical and scientific understanding: Educational use of mBot. Educational Technology Research and Development, 67(6), 1405–1425.

Sisman, B., Kucuk, S., & Yaman, Y. (2021). The effects of robotics training on children's spatial ability and attitude toward STEM. International Journal of Social Robotics, 13(2), 379–389. https://doi.org/10.1007/s12369-020-00646-9

Soto, A. M., Ruiz, M. J., & Aguilera, D. (2021). Technological inequality and STEM education in rural secondary contexts: Barriers to practical learning. Sustainability, 13(14), Article 7892. https://doi.org/10.3390/su13147892

Taole, M. J. (2020). Diversity and inclusion in rural South African multigrade classrooms. International Journal of Inclusive Education, 24(12), 1268–1284.

Tselegkaridis, S., & Sapounidis, T. (2021). Simulators in educational robotics: A review. Education Sciences, 11(1), Article 11. https://doi.org/10.3390/educsci11010011

Tytler, R., Prain, V., & Hobbs, L. (2021). Rethinking disciplinary links in interdisciplinary STEM learning: A temporal model. Research in Science Education, 51(1), 269–287.

Tzagkaraki, E., Papadakis, S., & Kalogiannakis, M. (2021). Exploring the use of educational robotics in primary school and its possible place in the curricula. In Proceedings of the Educational Robotics International Conference (pp. 216–229). Springer.

Wallace, D., & Poulopoulos, V. (2022). Bridging the socioeconomic gap in educational robotics: Access, equity, and STEM career pathways. Computers & Education, 184, Article 104512. https://doi.org/10.1016/j.compedu.2022.104512

Yang, W. (2022). Artificial intelligence education for young children: Why, what, and how in curriculum design and implementation. Computers and Education: Artificial Intelligence, 3, 100061.

Zhong, B., & Xia, L. (2020). A systematic review on exploring the potential of educational robotics in mathematics education. International Journal of Science and Mathematics Education, 18(1), 79–101.